PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Ice-making Apparatus

We, THE DOLE VALVE COMPANY, of 6201 Oakton Street, Morton Grove, Illinois, United States of America, a Corporation of the State of Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an automatic ice making apparatus and more particularly relates to a motor driven automatic ice making apparatus employing a distortable ice tray.

The flexible ice tray which forms a part of the present invention is preferably a one piece molded structure having a plurality of mold wells formed therein which is formed of high density linear polyethylene, although other types of flexible ice trays might also be satisfactorily employed. The use of high density polyethylene is desirable since this substance (1) is quite strong and durable, (2) resists cracking and tearing when twisted under low temperature conditions and (3) is relatively rigid while still permitting the desired amount of flexure of the tray. It has further been found that linear polyethylene is particularly adaptable for use in forming an ice tray since there is little tendency for ice blocks to adhere to the surface of this substance.

The ice tray is rectangular in configuration with a plurality of aligned mold wells therein and is adapted to be twisted about its longitudinal axis to effect, when in an inverted position, the ejection of ice blocks from the mold wells.

The aforementioned type of flexible ice tray is particularly suited for use in an ice making apparatus of the type herein disclosed since ice blocks are readily ejected from the mold wells therein upon the application of a very slight twisting action, in terms both of the degree of force and twist necessitated.

An ice making apparatus in accordance with the present invention comprises a support, first and second shafts journalled for rotation in the support, a flexible ice tray having one end mounted on the second shaft so as to be co-axial therewith, a drive element formed on each shaft for rotation therewith and together arranged to describe intersecting arcuate paths upon rotation thereof, means for rotating the first shaft in a first rotational direction, means limiting the degree of rotational movement of the end of the tray remote from said second shaft in an opposite rotational direction, and means biasing the second shaft in said opposite rotational direction.

A crank arm extends radially outwardly from one of the shafts which is, in turn, adapted to be rotatably moved by a second crank arm which is rotatably driven by a synchronous electrical motor. The motor is actuated through a compound electrical switch system whenever the level of ice blocks within a collection tray disposed beneath the ice tray is sufficiently low and when the water within the upwardly facing molds of the ice tray has frozen into ice blocks.

In order to sense the level of ice blocks within the collection tray, a sweep sensing arm has its opposite ends journalled within the upstanding supports and is rotatable therein to pass a portion of the arm over the collection tray. Rotatable movement of the sweep arm is affected by a cam and a complimentary element formed on one end of the sweep arm and the cam is, in turn, rotatably driven by the same motor which effects rotatable movement of the ice tray.

Switch means are associated with the sweep sensing arm so that when the arm is dropped from a raised position to a position to sense the level of ice blocks within the collection

tray and is prevented from moving through a complete arc by abutment with ice blocks within the collection tray, the switch will be actuated to de-energize the entire ice making apparatus. The components of the ice making apparatus are so arranged that the sweep sensing arm will not move into abutment with ice blocks within the collection tray until the level of ice blocks therein is quite high or until the collection tray has become filled.

The motor is indirectly energized as a function of the temperature of water within the ice tray by means of an analogue thermostat of a type which is well known in the art. The analogue thermostat comprises generally a thermal sensitive power element comprising a casing having an expansible material therein and having a power member which is extensible therefrom upon heating and consequent expansion of the material within the casing. When adapted to be utilized as an analogue thermostat for an ice making apparatus the thermal sensitive element has a resistor heater disposed in heat transfer relation therewith and this heater is energized through a switch actuated by movement of the power member to an extreme retracted position. The temperature sensitive portion of the thermal sensitive element is disposed within a water sink or the like which is disposed in the freezing compartment adjacent to the ice tray. The water sink is insulated and contains a sufficient volume of water so that the water therein will not freeze to effect switch energizing movement of the power member until sometime subsequent to the freezing of water within the ice tray. Upon freezing of water within the water sink, the power member will move to an extreme retracted position and actuate the heater switch which will energize the heater, raise the ambient temperature about the element, and cause expansion of the temperature sensitive material within the element. Upon such expansion, the power member wil be moved extensibly from the casing.

Extensible movement of the power member from the thermal sensitive element is effective to actuate a master switch which energizes the motor. Upon energization of the motor, the ice tray is rotated by the crank arms in the manner heretofore briefly described through an arc of approximately 120°. An abutment member is disposed in the path of movement of one corner of the ice tray and is arranged to prevent movement of that end of the ice tray through an arc greater than 120°. The motor, however, continues to rotate the shaft connected to the ice tray at the opposite end thereof through another 20° and this action is effective to twist the tray to effect ejection of ice blocks therefrom.

After one end of the ice tray has been rotated through this 140° arc, the crank arms move out of driving engagement with one another and the entire ice tray assembly is returned by means of a spring to a liquid receiving position.

Means are also provided to de-energize the motor at this point and the motor remains off until the analogue thermostat actuates its associated switch to re-energize the motor. Upon such re-energization of the motor, another switch is actuated which effects filling of the ice tray with liquid by an electrically energizable shut-off valve.

In order that the invention may be more readily understood, a preferred embodiment thereof will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a side elevational view of an ice making apparatus constructed in accordance with the present invention;

Figure 2 is a diagrammatic view of a wiring circuit which is employed to effect operation of the ice making apparatus illustrated in Figure 1;

Figure 3 is a plan view of the ice making apparatus illustrated in Figure 1 showing a portion of the casing for the cycling unit broken away;

Figure 4 is a fragmental vertical sectional view of the ice making apparatus taken along the line IV—IV of Figure 3;

Figure 5 is a transverse vertical sectional view through the ice tray when the ice tray is in a distorted condition;

Figure 6 is a fragmental side elevational view of the cam for operating the level sensing sweep arm;

Figure 7 is a side elevational view of the cam for effecting electrical actuation of the motor and the fluid shut-off valve;

Figure 8 is a fragmental partial elevational, partial sectional view of the crank arms, cams, and a pair of switches in a first position; and

Figure 9 is a view which is similar in nature to Figure 8 but which shows the crank arms and cams in a different rotated position.

Referring initially to Figure 1, the ice making apparatus is disposed within the freezing compartment 10 of a normal household refrigerator and includes a flexible ice tray 11, a control mechanism 12 therefor, and a collection tray 13 disposed beneath the ice tray 11 for collecting ice blocks ejected therefrom and resting on the base wall 14 of the freezing compartment 10.

As heretofore noted, the ice tray is preferably formed of linear high density polyethylene and includes a plurality of mold wells 15 having rounded bases from which side walls outwardly diverge to terminate in lips 16 (Figure 3). The lips 16 between all of the adjacent mold wells 15 have curvilinear

flow channels 17 formed therein which serve to communicate liquid between each of the several molds in the tray when water is dispensed into only one or two of the molds. The side rails 17*a* of the tray 11 are somewhat stiff to prevent sagging of the tray although they are flexible enough to permit longitudinal flexure thereof. The end rails 18 are rigidified by plates 19 so that if they are rotated through differential arcs, the mold wells 15, as viewed in plan, will retain the configuration of a parallelogram.

A pair of spaced supports 20 and 21 are connected to the upper wall 22 of the freezing compartment 10 and serve as a means for supporting the ice tray 11 and the tray control assembly 12. A pair of shafts 24 and 25 are pivotally connected to the plates 19 at opposite ends of the ice tray along the longitudinal axis of the tray and these shafts are journalled for rotatable movement in coaxially aligned apertures in the bracket supports 20 and 21. In addition, the shaft 25 is mounted for axial movement within the support 21 so that there will be no resistance to tray foreshortening when the tray is twisted. This feature, in addition to the pivotal mounting of the end rails 18 on the shafts 24, 25 permits the tray to be readily twisted in such a manner that, as viewed in plan, the mold wells will retain the configuration of a parallelogram. It will be understood that the tray is spaced a sufficient distance from the upper wall 22 of the freezing compartment 10 to permit rotation thereof through an angle exceeding 90° with respect to the horizontal.

Filling of the tray 11 with water is effected through energization of a fluid shut-off valve which is diagrammatically illustrated at 11*a* in figure 1. Water flows through a suitable conduit system from valve 11*a* to a filler spout 11*b* which terminates above the ice tray 11.

Referring to Figure 5 in conjunction with Figure 1, a lever 27 is pivotally mounted to the bracket 21 by means of a pin 28 and has an arcuate slot 29 formed therein which is adapted to receive a lock screw 30 which is screw threaded into the wall 21. The upper end portion of the lever 27 has an out-turned arm 31 which constitutes a stop disposed in the path of movement of one corner of the ice tray 11. When the lever 27 is so positioned that the out-turned arm 31 is disposed at the desired angular position with respect to the vertical, the lock screw 30 may be tightened down to fix the stop in this desired position.

It will be understood that no stop is provided for the opposite end of the ice tray 11 so that the tray 11 may be freely rotated from the horizontal toward the position illustrated in Figure 5. As one corner of the ice tray 11 strikes the out-turned arm or stop 31, continued rotation of the shaft 24 will act to twist and distort the ice tray 11. Such distortion of the tray, as shown in Figure 5, will be effective to dislodge ice blocks from their respective molds and to consequently drop those blocks into the collection tray 13.

Cushioned stops 32 and 33 extend outwardly from the depending support brackets 20 and 21, respectively, in the path of movement of the opposite ends of the ice tray 11 so that when the tray (as viewed in Figure 5) is rotated in a counterclockwise direction from the "ejecting" position, further rotation of the tray will be prevented by the stops 32, 33 after the tray has reached a horizontal, liquid receiving position. The stops 32, 33 are provided at each end of the ice tray 11 so that if a positive force is applied to the shaft 24 to rotate the tray to a liquid receiving position, the tray will be positively returned to its original configuration.

With particular reference now to Figures 8 and 9 in conjunction with Figure 3, a crank arm 40 is affixed to the outermost end of the shaft 24 on the opposite side of the support bracket 20 from the tray 11, which crank arm terminates in an inturned finger 41. A torsion spring 42 is wound about the shaft 24 intermediate the crank arm 40 and the support 20 and has one end abutting the inturned finger 41 and its opposite end abutting a post 43 so that it normally biases the ice tray in a counterclockwise direction (as viewed in Figure 5).

An electrical motor 45 is mounted on a faceplate 46 which, in turn, is mounted on the depending supporting bracket 20 by means of a plurality of support posts 47 as well as the support post 43. The motor 45 has an output power shaft 48 extending therefrom which, it is important to note, is not coaxially aligned with the shaft 24. In this respect attention is directed to Figure 4 in which the power shaft 48 is shown as having its longitudinal axis disposed slightly below the longitudinal axis of the shaft 24.

A crank arm 50 is mounted on the outermost end of the power shaft 48 for corotatable movement therewith and terminates in an out-turned finger 51 which, in turn, is co-operable with the finger 41 in predetermined rotated positions thereof to transmit power from the motor 45 to the shaft 24.

Transmission of power between the crank arms 50 and 40 is effected in the following manner: the crank arm 40 is illustrated in Figure 8 as being disposed at the limit of its clockwise rotated position. This limit of clockwise rotated position is, of course, determined by the fact that the crank arm 40 is connected to the shaft 24 which, in turn, is connected to the ice tray 11 which is prevented from further rotation by the stops 32, 33. In Figure 8 the finger 51 of the crank

arm 50 is shown as being disposed in juxtaposition to the finger 41 of crank arm 40. It will be understood that since the crank arms 40 and 50 are rotatable about axes which are eccentric with respect to one another, the mating faces of the fingers 41 and 51 will slide along one another as the crank arm 50 moves in a counterclockwise direction and as rotary motion is transmitted to the crank arm 40. It will be remembered that twisting and consequent distortion of the ice tray 11 is not effected until after the tray, and consequently the crank arm 40, has rotated through an arc of approximately 120°. The crank arms 40 and 50 are so designed and positioned that during the interval when tray distortion is being effected the largest portion possible of the mating faces of the fingers 41 and 51 will be in contact with one another.

Thus, power transmission from one crank arm to another is effected whenever any portion of the paths described by the mating drive fingers intersect. They are however so designed that over part of their rotation no portion of the arcuate path described by one finger will intersect with any portion of the path described by the other finger. Thus, ice tray twist is terminated at the instant that the paths described by the mating fingers diverge from one another.

Figure 9 illustrates the respective positions of the crank arms 40 and 50 just as the ice tray twisting action is about to terminate. During the latter part of the tray distortion cycle, the face of the finger 51 will move along the face the finger 41 toward the outer edge of the latter face until the crank arm 50 has rotated just slightly further in a counterclockwise direction from the position indicated in Figure 9. At such time the fingers 41 and 51 will move out of engagement with one another by a shearing action and the crank arm 40 and the tray 11 connected therewith will rapidly be returned to the positions illustrated in Figures 8 and 3, respectively, by the torsion spring 42.

Subsequently, the crank arm 50 will be further rotated in a counterclockwise direction by the motor 45 until the finger 51 again moves into engagement with the finger 41 to begin another cycle of operation.

The motor 45 is energized through a series of switches, one of which is the switch 60 having a movable contact 61 which is cooperable with a stationary contact 61a and which is operated as a function of the level of ice blocks within the container 13. A sweep arm 63 has oppositely disposed coaxially aligned out-turned ends 64 and 65 which are respectively journalled in the depending supporting brackets 20 and 21. The sweep arm 63 is so designed that it can sweep downwardly beneath the ice tray 11 and over the upper edge of the collection tray 13.

The out-turned end 64 of the sweep arm 63 is also journalled within the face-place 46 and has a radially extending arm 65 mounted thereon for co-rotatable movement therewith, upon which is mounted the switch 60, having its actuating plunger 67 extending outwardly therefrom. A leg 69 is pivotally mounted on the leg 66 at a point eccentric from the shaft 64 and is engageable with the plunger 67. A curvilinear end 70 of the leg 69 constitutes a cam follower which rides along the edge of a spiral cam 72 which, in turn, is mounted on the output power shaft 48 of the motor 45 for co-rotatable movement therewith. As shown most clearly in Figure 6, the cam 72 has a spirally shaped peripheral surface 73 which terminates abruptly in a relieved portion 74.

When the curvilinear end portion 70 of the leg 69 is disposed in engagement with the relieved portion 74 of cam 72 the leg 69 will be disposed in its counterclockwise rotated position which is illustrated in Figures 6 and 8. When the leg 69 is so disposed, the torsion spring 76 will act to normally bias the leg 66 to a counterclockwise rotated position as shown in Figure 8 so that the leg 69 will act to depress the plunger 67 of the switch 60.

Upon rotation of the cam 72 in a counterclockwise direction from the position illustrated in Figure 8 to the position illustrated in Figure 9 the curvilinear end portion of the leg 69 will ride along the spirally shaped peripheral edge of the cam 72 and will act to urge the leg 69 to pivot in a clockwise direction about its point of pivotal connection with the leg 66 and will act through the plunger 67 of switch 60 to also urge the leg 66 to a clockwise rotated position against the opposing biasing force of spring 76. An adjustable pin 66a is threadedly mounted within the leg 66 to absorb the driving force between legs 66 and 69 but it does not interefere with actuation of the switch 60.

It will be observed that when the cam follower 70 of leg 69 is disposed in engagement with the relieved portion 74 of the cam 72 the sweep sensing arm 63, connected to leg 66, will be permited to drop over the collection tray 13.

In each of the foregoing instances, however, the legs 69 and 66 have been spaced by the same relative distance. Referring now more particularly to Figure 6 it will be observed that when the cam 72 has rotated to a position to dispose the curvilinear cam follower 70 in engagement with the relieved portion 74 thereof, the sweep sensing arm 63 will be permitted to drop over the collection tray 13. If, however, the sweep sensing arm 63 is prevented from moving through

a complete pivotal stroke (as where such movement is prevented by ice blocks within the tray 13 disposed above the level of the tray in the path of movement of the sweep arm 63) the leg 69 will move in a counterclockwise direction as heretofore described but counterclockwise rotatable movement of the arm 63 and the leg 66 will be prevented. This fact will cause relative movement between the outer ends of the legs 66 and 69 and will act to move the leg 69 out of engagement with the plunger 67. If the movable contact 61 of switch 60 is normally biased to an open circuit position by a spring 61*b* (as shown diagrammatically in Figure 2) then relative separation between the legs 66 and 69 will act to open the circuit through the switch and consequently de-energize the motor 45.

Energization of the fluid shut-off valve 11*a* and actuation of the motor 45 is effected through a pair of switches 80 and 81 which are serially connected to the switch 60. All of these switches may comprise snap-action switches but, for the sake of clarity, the following description of switch operation is not limited to any particular type of switch; on the contrary, reference is made broadly to movable and stationary switch contacts.

The analogue switch 80 is a double-throw switch having a movable contact 82 and a pair of stationary contacts 83 and 84. This switch is associated with and operated by the power element 85 of an analogue thermostat 86 which is mounted within the depending support 20 with its temperature sensitive portion disposed in the freezing compartment 10. The analogue 86 is of a type which is well known in the art and so is not herein described in detail.

Generally, the analogue 86 comprises a housing 88 within which a thermal sensitive element is disposed. The thermal sensitive element may be of the "solid fill" type having an expansible material therein which is adapted to expand when the ambient temperature therearound has been raised to a predetermined critical temperature. Thermal sensitive elements generally have a power member such as the power member 85 which is extensible therefrom upon expansion of the fusible material therein. The outer wall of the thermal sensitive element is spaced from the inner wall of the housing 88 and a liquid is disposed within this space which may have approximately the same rate of freezing as the liquid to be frozen into ice blocks within the ice tray 11. This rate of freezing is controlled by the insulative characteristics of the housing and the volume of water contained therein. This liquid filled space constitutes a so-called "water sink". Assuming that the liquid within the housing 88 is initially at approximately the same temperature as the water within the ice tray 11, the temperature of the liquid disposed within the housing 88 will not be lowered to permit extreme retractable movement of the power member until the water within the ice tray 11 has frozen into ice blocks.

The switch 80 is mounted by means of a support 89 in the path of movement of the power member 85 and is so arranged that the movable contact 82 thereof is biased into engagement with the stationary contact 84 by a spring 90. The parts are so arranged that the contact 82 will not move into engagement with the contact 84 until the power member has moved to an extreme retracted position and the water within the ice tray has been frozen into ice blocks. A heater coil 104, which is diagrammatically illustrated in Figure 2, is disposed in heat transfer relation with the water sink, which when energized through the switch 80, will raise the temperature thereof and effect extensible movement of the power member 85. The switch 80 is snap switch which is designed so that the contact 82 will not move out of engagement with the contact 84 until the power member has moved almost to the limit of its extensible stroke.

The switch 81 is a compound switch having a pair of movable contacts 93 and 94 which are interconnected by a member 101. The contact 93 is engageable with stationary contact 95, through which the solenoid coil 96 of the shut-off valve 11*a* is energized, and is normally biased out of engagement with contact 95 by a diagrammatically illustrated spring 97. When the circuit through the contacts 93 and 95 is closed, energization of the solenoid 96 will effect opening of the shut-off valve to permit fluid to flow to the ice tray.

The contact 94 is a double-throw contact which is co-operable with a pair of contacts 98 and 99 and is normally biased into engagement with the contact 98 by a diagrammatically illustrated spring 100.

It will be understood that the contacts 93 and 94 are so connected with one another that they are not necessarily disposed in parallel relation and that the movable contacts 93 and 94 are resilient so that by moving the interconnecting member 101, the contact 94 may be moved out of engagement with stationary contact 98 and into engagement with stationary contact 99 while the movable contact 93 remains in engagement with a "dead" contact 102. That is, as viewed diagrammatically in Figure 2, upward movement of the interconnecting member 101 will act to hysteretically close the circuit through the stationary contact 95 with respect to closure of the circuit through the stationary contact 99.

The opposite ends of the movable contacts 93 and 94 are "jumpered" and lead to one

side of the motor 45; the opposite side of the motor being connected to earth.

The resistor heater 104 has one side connected to earth and has its opposite side connected to a lead wire 105 interconnecting contacts 84 and 98. A second lead wire 106 serves to interconnect contacts 83 and 99.

As best viewed in Figures 8 and 9, a cam follower 110 extends from the switch 81 and is engageable with portions of the peripheral surface of a cam 111 which, in turn, is connected to the output power shaft 48 of the motor 45 for co-rotatable movement therewith. As viewed most clearly in Figure 7 the cam 111 has a relieved portion 112 which terminates in a first stepped portion 113 (having a greater radius than the relieved portion 112) and the first stepped portion in turn terminates in a second stepped portion 114 (having a greater radial dimension than the stepped portion 113). A shoulder 115 interconnects the second stepped portion 114 with the relieved portion 112.

It will be observed that when the cam 111 is disposed in the position illustrated in Figure 8 the springs 97 and 100 serve to bias the movable contacts 93 and 94 into engagement with stationary contacts 102 and 98, respectively. When the cam 111 has rotated a sufficient distance to dispose the outermost end of the cam follower 110 in engagement with the first stepped portion 113, the interconnecting member 101 will be moved a sufficient distance to snap the movable contact 94 into engagement with the stationary contact 99 but such movement of the interconnecting member 101 will not be sufficient to move contact 93 into engagement with contact 95.

When the cam 111 has rotated further in a counterclockwise direction to place the outer end portion of the cam follower 110 in engagement with the second stepped portion 114, the interconnecting member 101 will then be moved a sufficient distance to snap the movable contact 93 into engagement with stationary contact 95. When the cam has further rotated to a point wherein the shoulder 115 passes the end of the cam follower 110 the contacts 93 and 94 will again be snapped back into engagement with contacts 102 and 98 by the springs 97 and 100, respectively.

Assuming that movable contacts 61, 93, and 94 are initially in engagement with stationary contacts 61a, 102, and 98, respectively, the operation of the ice making apparatus will be substantially as follows: subsequent to freezing of the liquid within the mold wells 15, the ambient temperature about the thermal sensitive element within the analogue 86 will be lowered to a point to permit extreme retractable movement of the power member thus energizing the heater 104 and moving the power member extensibly. An energizing circuit to the motor 45 will thus be closed through switches 60, 80, and 81 during the interval when the thermal sensitive element is being heated so that rotation of the shaft 48 will be effected. During the interval when the curvilinear cam follower 70 rides on the relieved portion 74 of cam 72, the level of ice within the collection tray 13 will be sensed. If the level of ice is so high as to be in the path of movement of the sweep sensing arm 63 the movable contact 61 of switch 60 will be moved to an open circuit position to deenergize the entire ice making apparatus. Assuming, however that the ice level is not that high, the contact 61 will remain closed and the shaft 48 and the elements connected thereto will continue to rotate.

Distortion of the ice tray 11 will subsequently be effected in the manner above described and shortly thereafter, as viewed in Figure 9, the cam follower 110 will move into engagement with the first stepped portion 113 of cam 111 to snap the movable contact 94 into engagement with stationary contact 99. At such time, of course, the motor 45 will be deenergized. During this interval and for a short duration thereafter, the resistor heater 104 will be energized to slowly extensibly move the power member 85. When the power member reaches the limit of its stroke, the contact 82 will be moved into engagement with contact 83. Thereupon the motor 45 will again be energized through the contact 83 and 99 and further counterclockwise rotation of the power shaft 48 will be effected.

It is important to understand that up to this point in the cycle the movable contact 93 has at all times remained in engagement with the stationary "dead" contact 102.

Further rotation of the power shaft 48 will subsequently move the second stepped portion 114 of the cam 111 into engagement with the cam follower 110 to further move the interconnecting member 101 and to consequently move the movable contact 93 into engagement with stationary contact 95. Upon closure of the electrical circuit through contact 95, the solenoid 95 will be energized and fluid will flow through the filler spout 116 to the ice tray 11. The tray 11 will, of course, have been returned by the torsion spring 42 to a liquid receiving position.

It is important to understand that the motor is permitted to run to rotate the shaft 48 and the cams connected therewith through a substantial arc before closure of the contact 95 is effected because filling of the tray 11 is effected as a function of the time and not as a function of water volume. Since the speed of rotation of the output shaft is more steadily predictable when the motor is running steadily rather than when it is just

starting, such filling "on the run" will result in the direction of a more readily predictable volume of fluid to the ice tray.

As long as the cam follower 110 is in engagement with the stepped portion 114 of cam 111 the solenoid 96 of the shut-off valve 11*a* will be energized and fluid will be directed to the tray 11 through filler spout 11*b*. The length of the stepped portion 114 is therefore determinative of the volume of fluid which will be dispensed to the ice tray. When the shoulder 115 of the cam 111 has moved past the cam follower 110 the springs 97 and 100 will bias the movable contacts 93 and 94 back into engagement with stationary contacts 102 and 98, respectively. The motor 45 will thus be deenergized, inasmuch as the movable contact 82 is disposed in engagement with stationary contact 83. Subsequent cycling of the mechanism will therefore not be effected until the analogue has been effective to permit movement of the contact 82 into engagement with contact 84 to initiate another cycle of operation.

An automatically operable ice making apparatus is thus provided which will be effective to continually produce ice blocks and dispense them into the collection tray 13 in an automatic fashion until the operation thereof is terminated by the level sensing mechanism hereinbefore described.

It will of course be understood that this embodiment of the invention has been used for illustrative purposes only and that various modifications and variations in the present invention may be effected without departing from the scope of the invention as defined by the appended claims.

WHAT WE CLAIM IS:—

1. An ice making apparatus comprising a support, first and second shafts journalled for rotation in the support, a flexible ice tray having one end mounted on the second shaft so as to be co-axial therewith, a drive element formed on each shaft for rotation therewith and together arranged to describe intersecting arcuate paths upon rotation thereof, means for rotating the first shaft in a first rotational direction, means limiting the degree of rotational movement of the end of the tray remote from said second shaft in an opposite rotational direction, and means biasing the second shaft in said opposite rotational direction.

2. An ice making apparatus according to claim 1, in which the shafts are journalled for rotation about eccentric axes, the end of the tray remote from the second shaft being limited in its movement in each rotational direction, the drive elements being arranged to be able to rotate the end of the tray adjacent to the second shaft through a greater arc than the end remote therefrom, and the first shaft being rotatable by a motor.

3. An ice making apparatus according to claim 1 or 2, which includes sensing means for detecting the level of ejected ice blocks beneath the tray and first switch means connected to said sensing means arranged to de-energize the means for rotating the first shaft when the ice blocks beneath the tray reach a predetermined level.

4. An ice making apparatus according to any preceding claim, which includes means for filling the ice tray with liquid and switch means operable as a function of the degree of rotation of the first shaft for energizing the filling means.

5. An ice making apparatus according to any preceding claim, which includes means operable as a function of the rate of freezing of the liquid within the ice tray for controlling the energization of the means for rotating the first shaft.

6. An ice making apparatus according to claim 5, in which said means operable as a function of the rate of freezing of the liquid comprises an analogue thermostat.

7. An ice making apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

8. Ice, when made in an apparatus according to any of the preceding claims.

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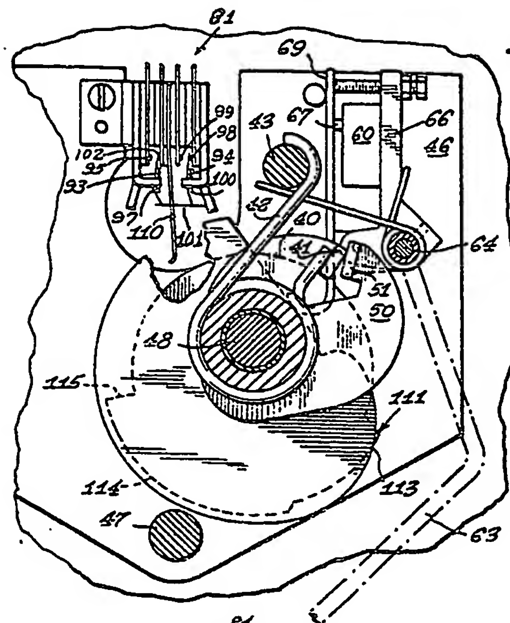
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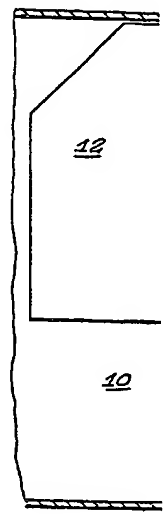
FIG. 8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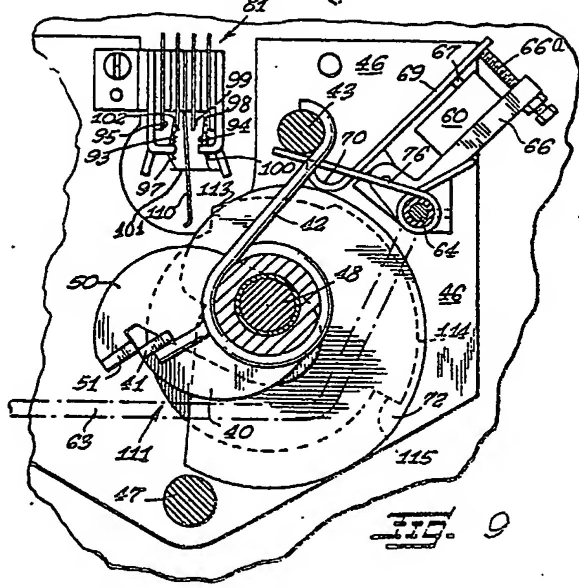
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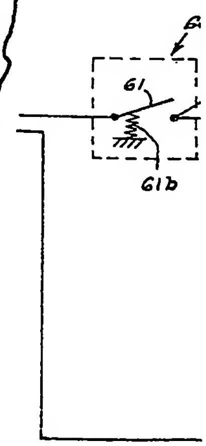
FIG. 9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Sheet 1

Fig. 8

Fig. 1

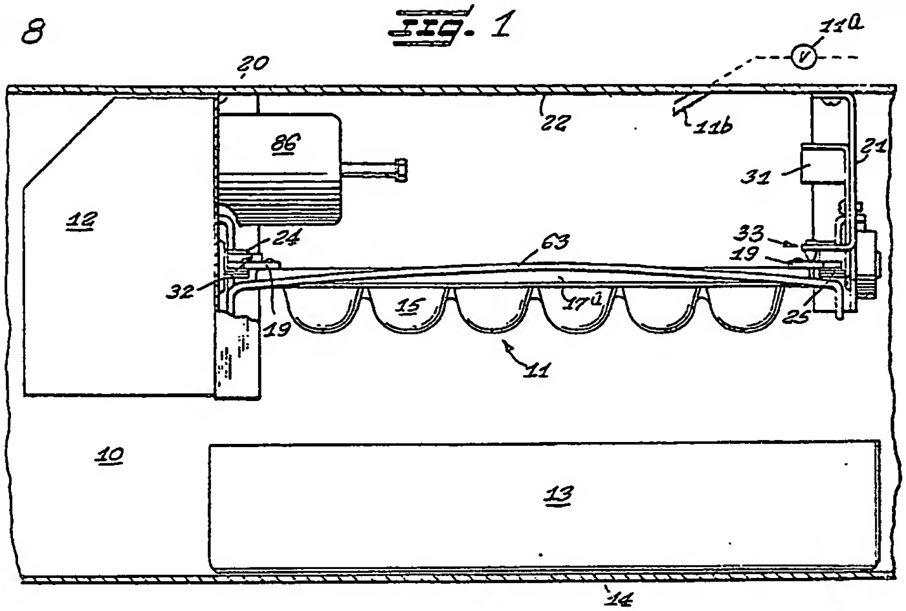
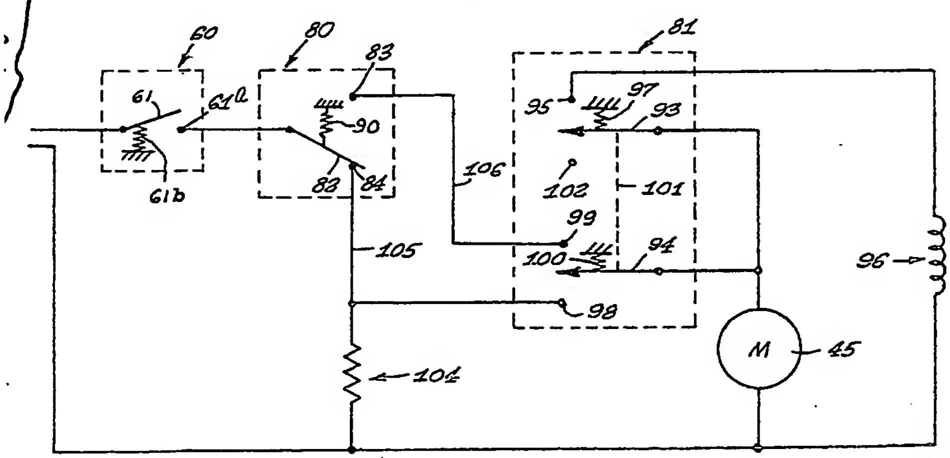


Fig. 2



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COMPLETE SPECIFICATION

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Sheet 1

FIG. 8

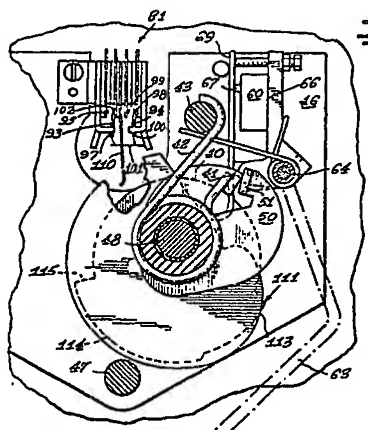


FIG. 1

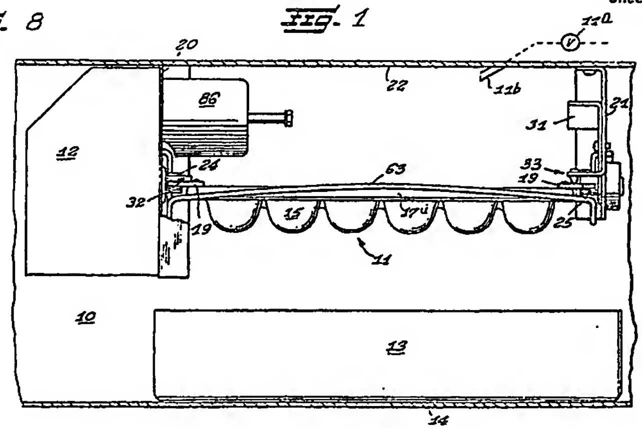
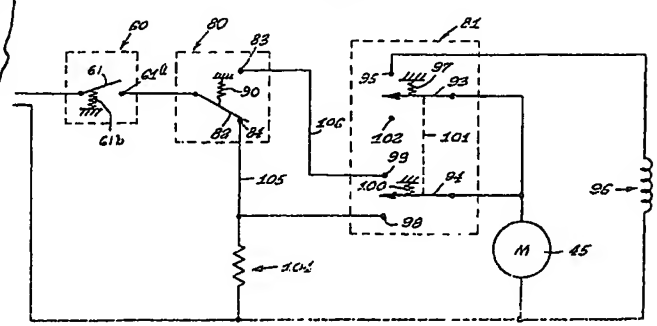


FIG. 2



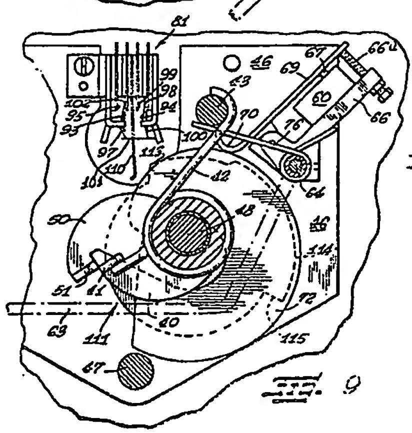


FIG. 9

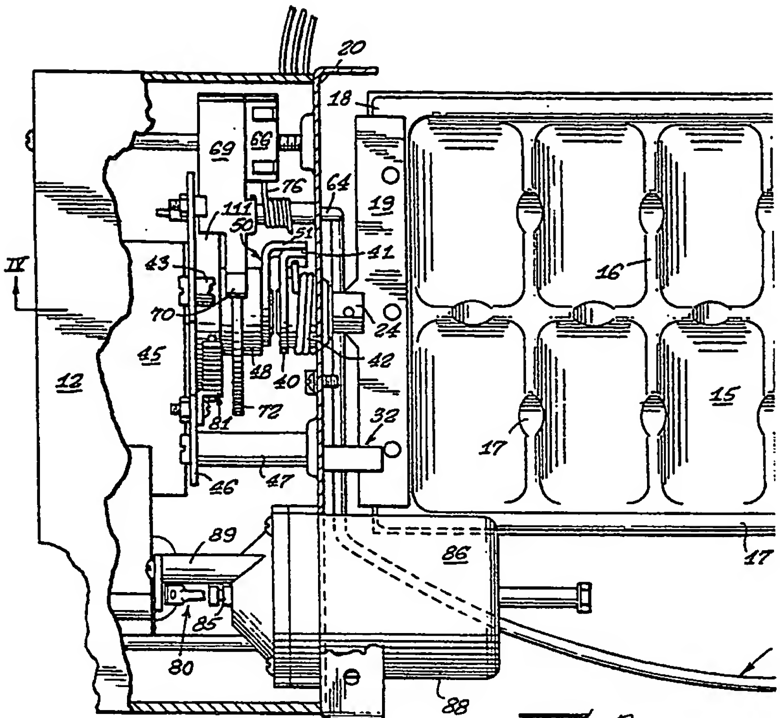

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FIG. 3

977699 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

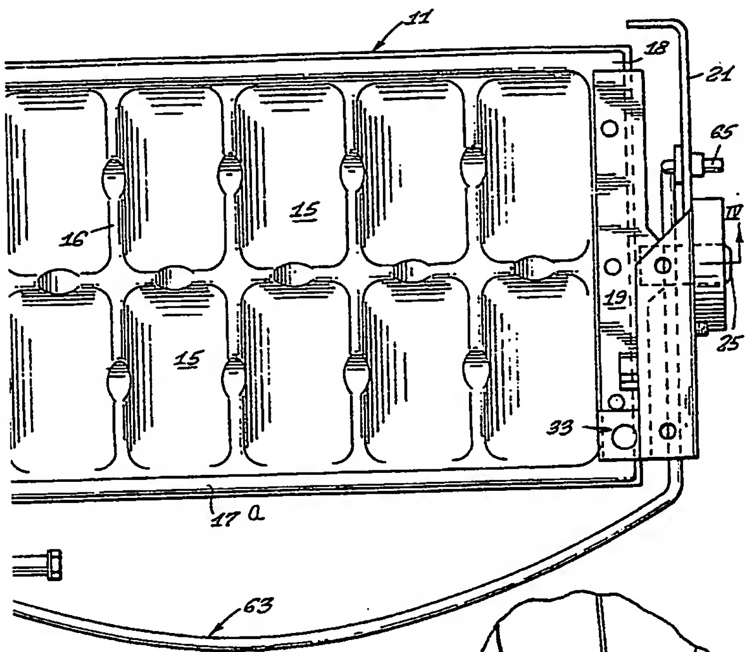

FIG. 3

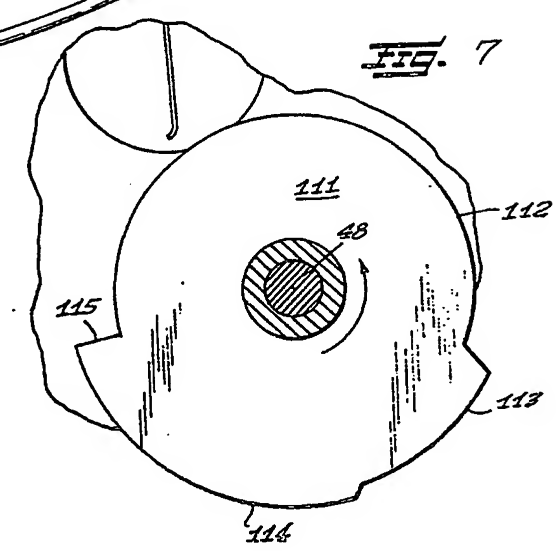

FIG. 7

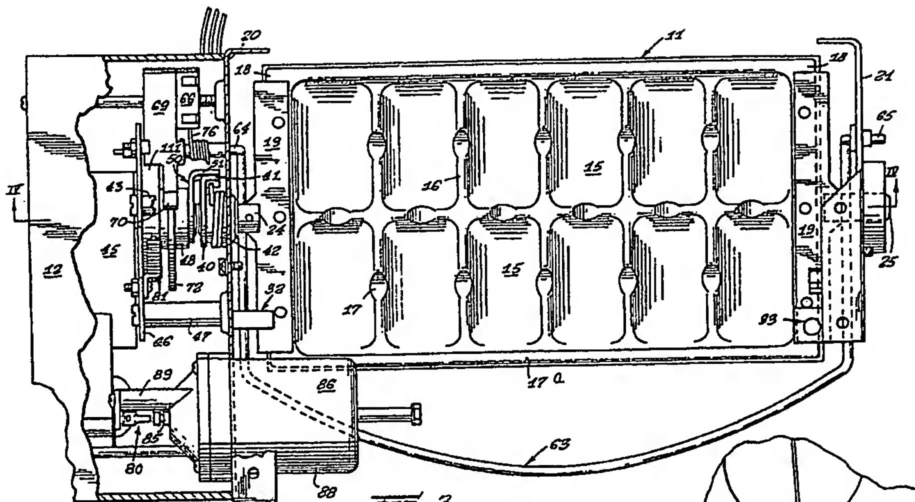
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FIG. 3

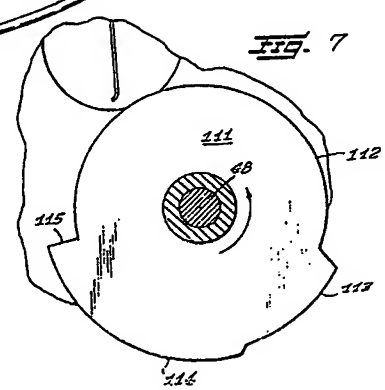
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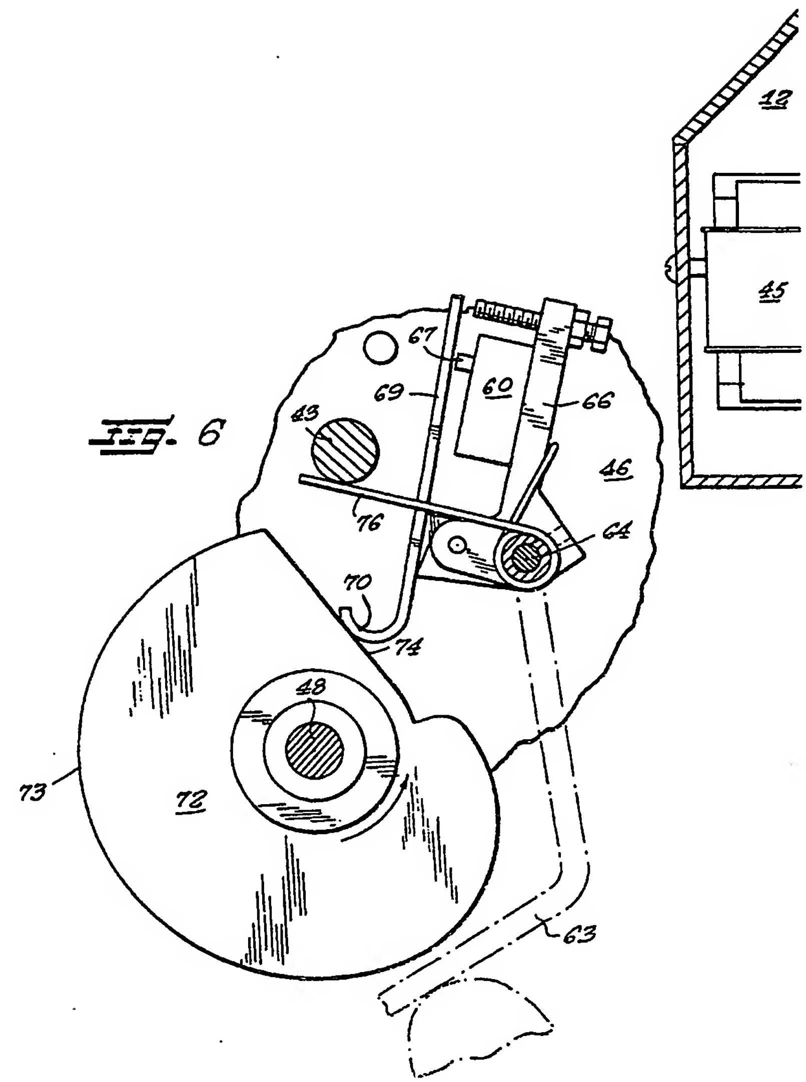
FIG. 7

FIG. 6



977699 COMPLETE SPECIFICATION

3 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 3

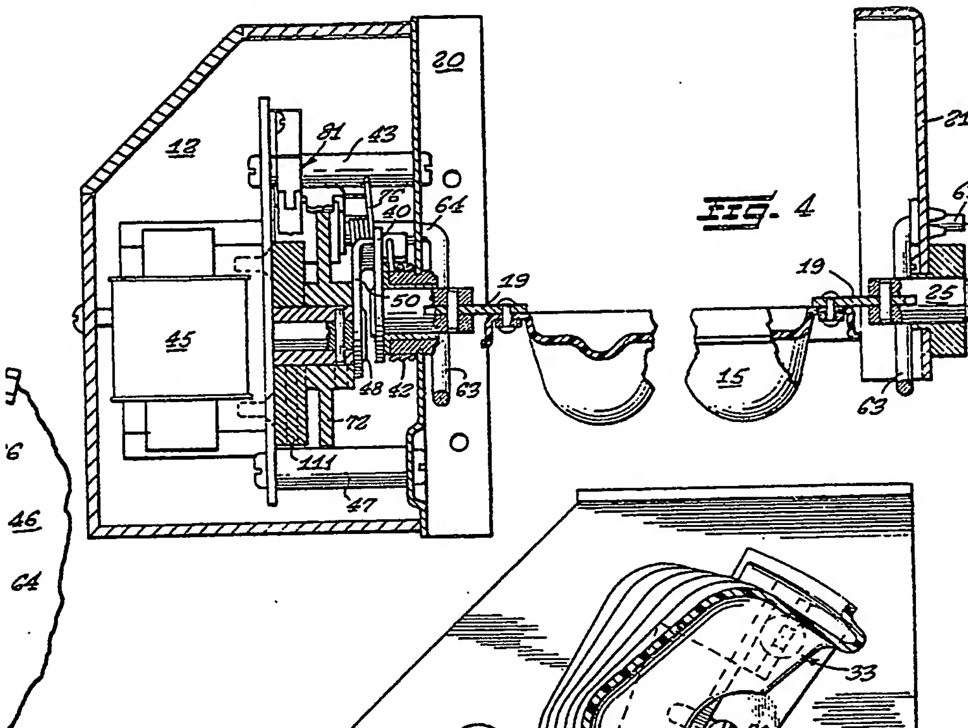


FIG. 4

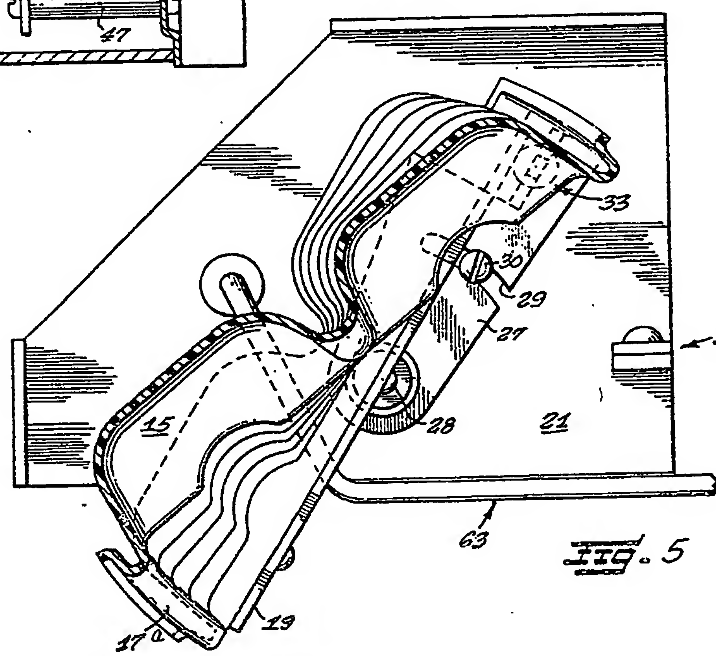


FIG. 5

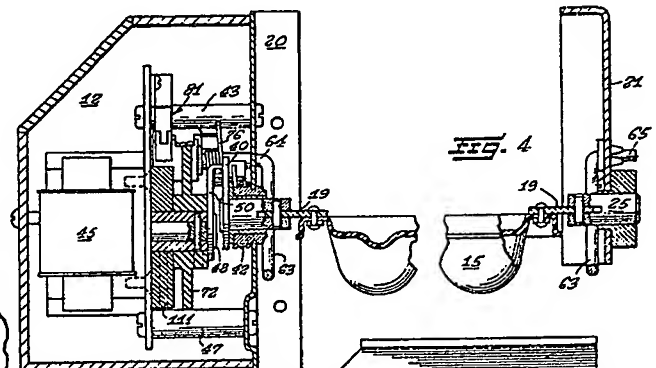


FIG. 4

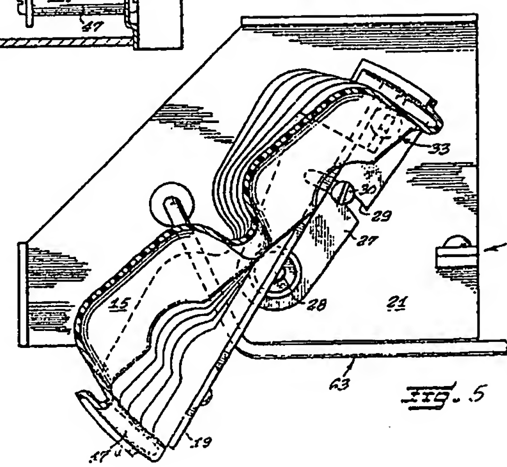


FIG. 5

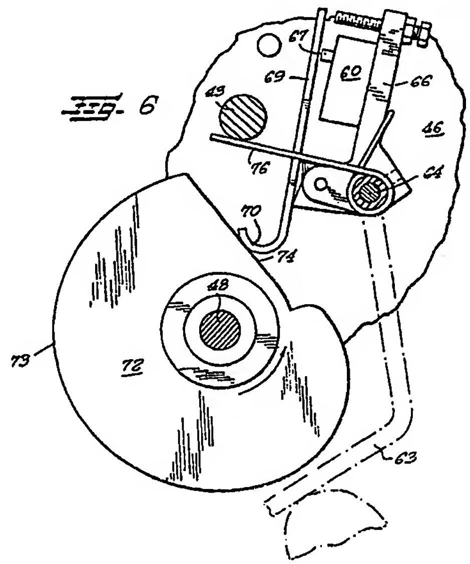


FIG. 6